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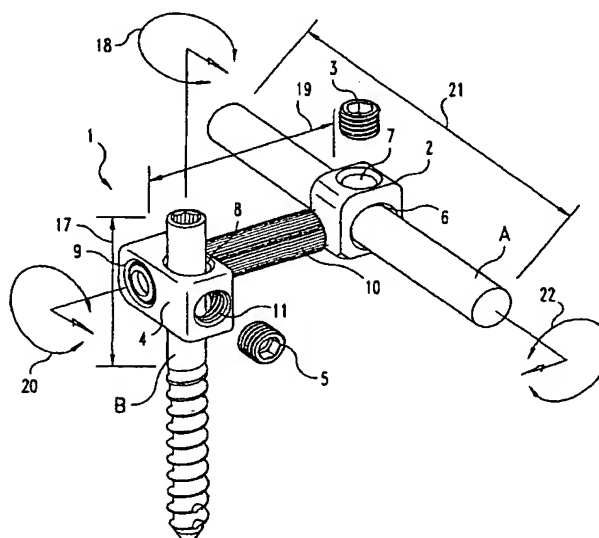
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09/694,703 23 October 2000 (23.10.2000) US
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- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
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[Continued on next page]

(54) Title: **SIX-AXIS AND SEVEN-AXIS ADJUSTABLE CONNECTOR**



(57) Abstract: A connection assembly between a spinal implant rod (A) and a vertebral anchor (B). The connection assembly includes a spindle (2) and a spindle block (4). The spindle has an aperture (6) for receiving a spinal implant rod (A) in a spinal implant system. And structure for urging the rod within the aperture, such as the setscrew (3), is provided through a suitable threaded opening (7) in the spindle so as to be extendable into the aperture (6). The spindle block (4) has an aperture (8) for receiving a shaft or shank of a vertebral anchor (B) of a spinal implant system. The spindle block also has an aperture (9) for receiving a generally cylindrical projection portion (10) of the spindle. Structure for urging the shank of the vertebral anchor against the projection portion, such as a setscrew (5), is provided through a suitable threaded opening (11) in the spindle block.

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## SIX-AXIS AND SEVEN-AXIS ADJUSTABLE CONNECTOR

5        This invention relates to a spinal implant assembly, and more particularly to a spinal implant connection assembly.

### BACKGROUND OF THE INVENTION

Spinal implant systems provide a rod for supporting the spine and for properly positioning components of the spine for various treatment purposes.

10    Bolts, screws, and hooks are typically secured to the vertebrae for connection to the supporting rod. These vertebral anchors must frequently be positioned at various angles due the anatomical structure of the patient, the physiological problem being treated, and the preference of the physician. It is difficult to provide secure connections between the spinal support rod and these vertebral anchors at

15    all the various angles and elevations that are required, especially where there are different distances between the rod and bolts and where these components are located at different heights on the patient.

What is needed is a connection assembly between a spinal rod and a vertebral anchor that allows the surgeon to fix the desired elevation between a rod

20    and the bone anchor as well as fix the desired angle between the anchor and rod. The following invention is one solution to that need.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of one embodiment of the present invention.

Fig. 2 is a perspective view of a spindle block used in one embodiment of the present invention.

5        Fig. 3 is a perspective view of a spindle used in one embodiment of the present invention.

Fig. 4 is a perspective view of a vertebral anchor with which the present invention may be used.

10       Fig. 5 is a perspective view of a spinal implant rod with which the present invention may be used.

Figs 6 and 7 are perspective views of one means for connecting a vertebral anchor to the spindle at a variable angle.

Figs 8 and 9 are perspective views of another means for connecting a vertebral anchor to the spindle at a variable angle.

15       Figs 10, 11, and 12 are perspective views of yet another means for connecting a vertebral anchor to the spindle at a variable angle.

profile of aperture 9. Opening at 16 in this manner allows the shaft of a vertebral anchor "B", residing in aperture 8, to contact the projection portion 10 of spindle 2, residing in aperture 9. Moreover, the intersection of these profiles should be sufficiently large to allow vertebral anchor "B" to force projection portion 10 against the inside wall of aperture 9 when set screw 5 is threaded against vertebral anchor "B". Or, the intersection of these profiles should be sufficiently large to allow projection portion 10 to force vertebral anchor "B" against the inside wall of aperture 8 when a set screw (not shown) is threaded into aperture 9 and against projection portion 10. Tightened in either manner, projection 10 and anchor "B" are clamped between setscrew 5 and the inside wall of apertures 8 or 9, thusly locking vertebral anchor "B" to spindle 2. Which, when spindle 2 is tightened to rod "A", clamps vertebral anchor "B" to rod "A".

An advantage of this invention is that the surgeon may adjust the clamp in six manners. The first adjustment 17 is that the surgeon can locate spindle block 4 anywhere along the shank of vertebral anchor "B". The second adjustment 18 is that the surgeon can locate spindle block 4 in most any angle around vertebral anchor "B". The third adjustment 19 is that the surgeon can locate spindle block 4 anywhere along the length of projection portion 10. The fourth adjustment 20 is that the surgeon can locate spindle block 4 in most any angle around projection portion 10. The fifth adjustment 21 is that the surgeon can locate spindle 2 anywhere along the length of rod "A". The sixth adjustment 22 is that the surgeon can locate spindle 2 in most any angle around rod "A".

One alternative embodiment of this invention would also provide a seventh method adjustment. Instead of using spindle block 4, the practitioner of this invention could also use a connector 23 that will provide for engagement of the spindle to the vertebral anchor where the vertebral anchors are at a variety of angles relative to the vertical when the patient is lying down.

A first example of such a connector 23 is shown in Figs 6 and 7. Connector 23 includes a rod or spindle connecting member 24 having an aperture 25 for receiving a portion of the rod or spindle 2 and a bolt connecting member 26 having an aperture 27 for receiving a portion of the bolt or vertebral anchor. The rod or spindle connecting member and bolt connecting member are rotatably engaged to

Additional details of this connector can be found in U.S Patent Application Serial No. 09/526,104 to Morrison, the disclosure of which is specifically incorporated into this specification by reference.

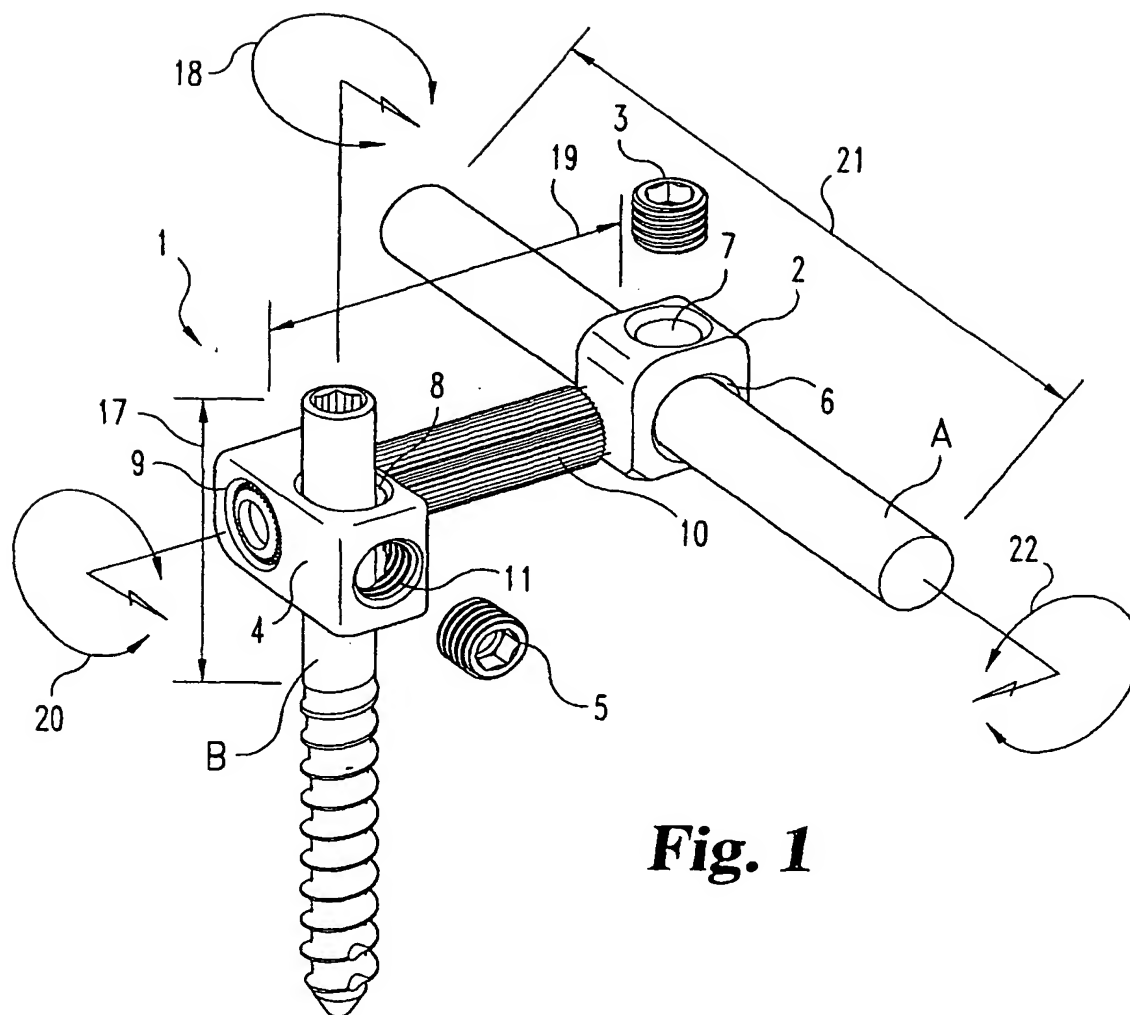
An alternative embodiment of connector 31 is shown in Figs. 10 to 12.

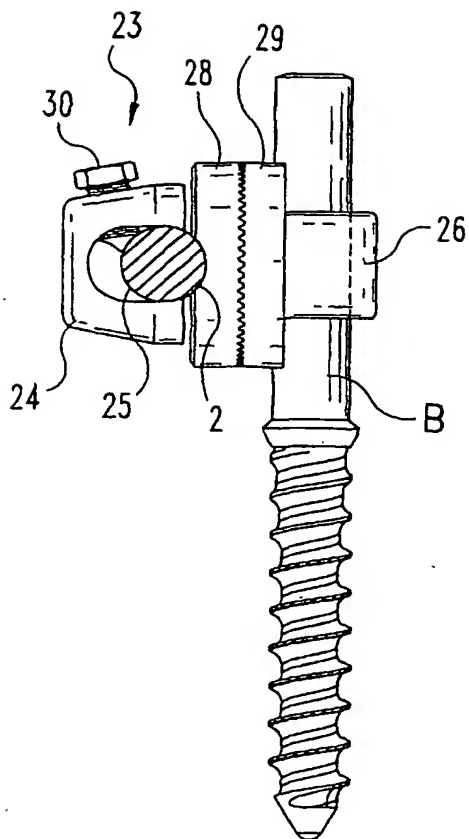
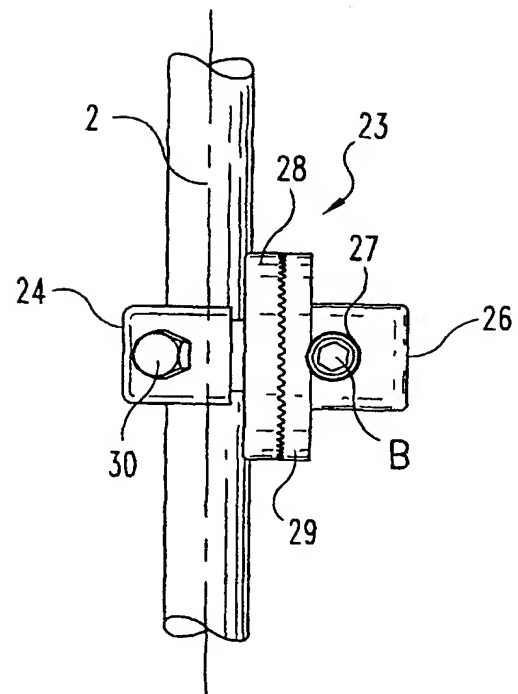
- 5 Instead of using stop 33, bolt 32 is rotably attached or threaded directly into ear 38. Attached in this manner, stop 33 is no longer necessary.

- While the invention has been illustrated and described in detail, this is to be considered illustrative and not restrictive of the patent rights. The reader should understand that only the preferred embodiments have been presented and all  
10 changes and modifications that come within the spirit of the invention are included if the following claims or the legal equivalent of these claims describes them.

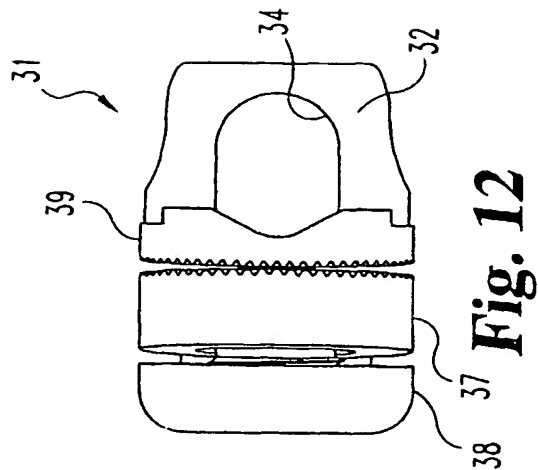
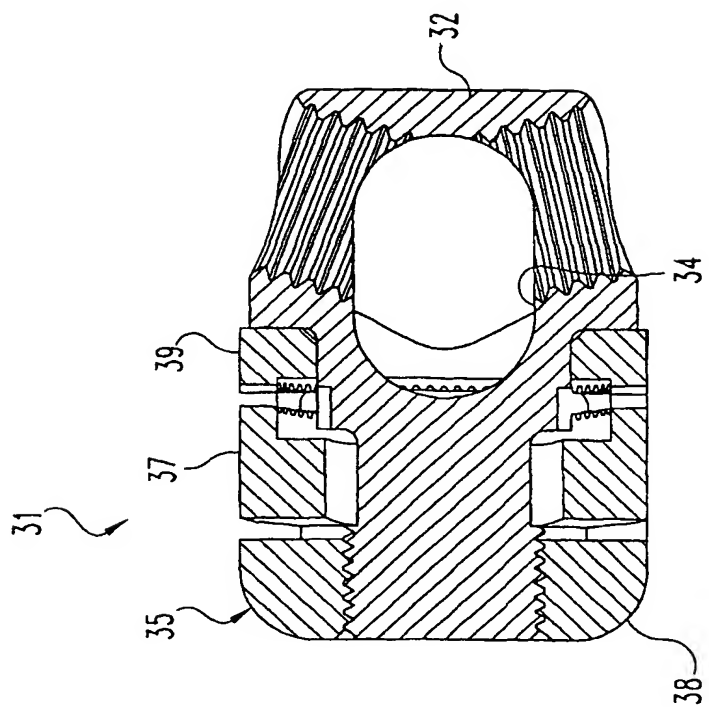
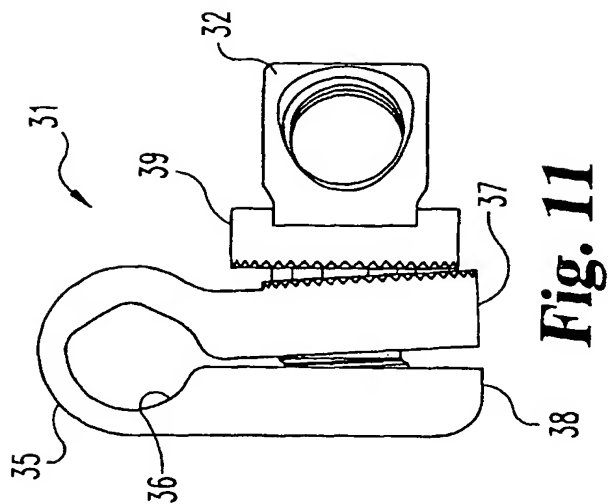
8. A connection assembly between a spinal implant rod and a vertebral anchor, the assembly comprising:
- (a) a spindle, said spindle having a first aperture with internal walls for receiving a portion of a spinal implant rod;
- 5 (b) a first compression member threadably engageable into said spindle to urge a spinal implant rod against the internal walls of the first aperture;
- (c) a spindle block, said spindle block having a second aperture with walls for receiving a portion of said spindle and a third aperture with walls for receiving a portion of the vertebral anchor, wherein the walls of the second
- 10 aperture define a first cylinder and the walls of the third aperture define a second cylinder, and wherein the first cylinder intersects the second cylinder; and
- (d) a second compression member threadably engageable into spindle block to urge the spindle against the vertebral anchor, whereby the spindle and the
- 15 vertebral anchor will be pressed together, securing the spindle block to the vertebral anchor and the spindle.
9. The connection assembly of claim 8, wherein said spindle has a projection portion with surface, a length, and a constant diameter over said length.
10. The connection assembly of claim 9, wherein the projection portion is
- 20 hollow.
11. The connection assembly of claim 9, wherein the surface of the projection portion contains parallel ridges.
12. The connection assembly of claim 8, wherein the first aperture of said spindle has internal ridges.
- 25 13. The connection assembly of claim 8, wherein the second aperture of said spindle block has internal ridges.
14. The connection assembly of claim 8, wherein the third aperture of said spindle block has internal ridges.

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**Fig. 1**

**Fig. 6****Fig. 7**





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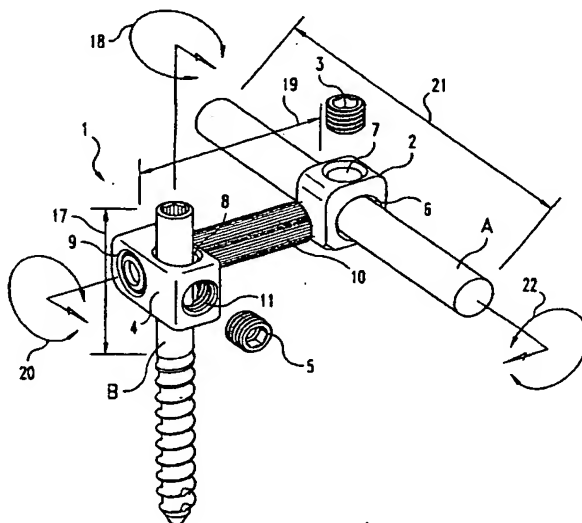
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- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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(54) Title: **CONNECTOR FOR SPINAL ROD AND VERTEBRAL ANCHOR**



(57) Abstract: A connection assembly between a spinal implant rod (A) and a vertebral anchor (B). The connection assembly includes a spindle (2) and a spindle block (4). The spindle has an aperture (6) for receiving a spinal implant rod (A) in a spinal implant system. And structure for urging the rod within the aperture, such as the setscrew (3), is provided through a suitable threaded opening (7) in the spindle so as to be extendable into the aperture (6). The spindle block (4) has an aperture (8) for receiving a shaft or shank of a vertebral anchor (B) of a spinal implant system. The spindle block also has an aperture (9) for receiving a generally cylindrical projection portion (10) of the spindle. Structure for urging the shank of the vertebral anchor against the projection portion, such as a setscrew (5), is provided through a suitable threaded opening (11) in the spindle block.

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## INTERNATIONAL SEARCH REPORT

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## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A61B17/70

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	13 May 1994 (1994-05-13) figures	1,8
A	EP 0 982 007 A (DEPUY ACROMED) 1 March 2000 (2000-03-01) figure 2	1,8,15
P,X	FR 2 806 902 A (J.C.BOUVET) 5 October 2001 (2001-10-05) page 3, line 24 -page 5, line 13; figures 1,2	1-18

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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8 May 2002

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Name and mailing address of the ISA

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## INTERNATIONAL SEARCH REPORT

Information on patent family members

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